# Special SCADA Overview (aka “SCADA-Bowl”)

Matthew E. Luallen, Encari

mluallen@encari.com

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# Game Plan

- Understanding the Risk (Known Examples of Vulnerabilities & Countermeasures)
- Critical Infrastructure Protection (Example Regulations)
- Simple Principles to Reflect Upon
- Risk, Key Takeaways, Q&A

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# What are the plays of the game? Vulnerabilities and Countermeasures

# Man-in-the-Middle Attacks* (1 of 7)

- Attacker reads, inserts and modifies information without either party aware
  - Physical Layer
  - Datalink Layer
  - Network Layer
  - Application Layer
  - System Layer
  - Social Layer

- What can happen?
  - Incorrect information is conveyed to the operator in a trusted manner
  - Incorrect control settings are sent to the system in a trusted manner
- Control is completely taken over by attacker

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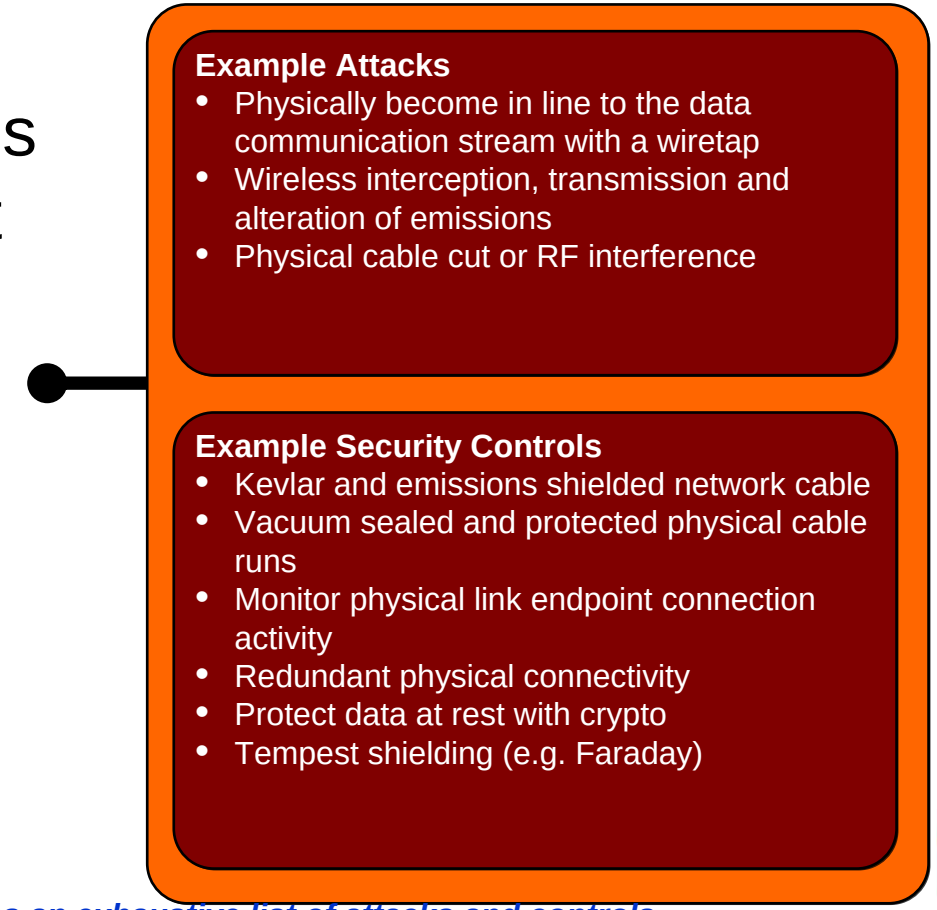
** Not to be considered as an exhaustive list of attacks and controls*

# Man-in-the-Middle Attacks* (2 of 7)

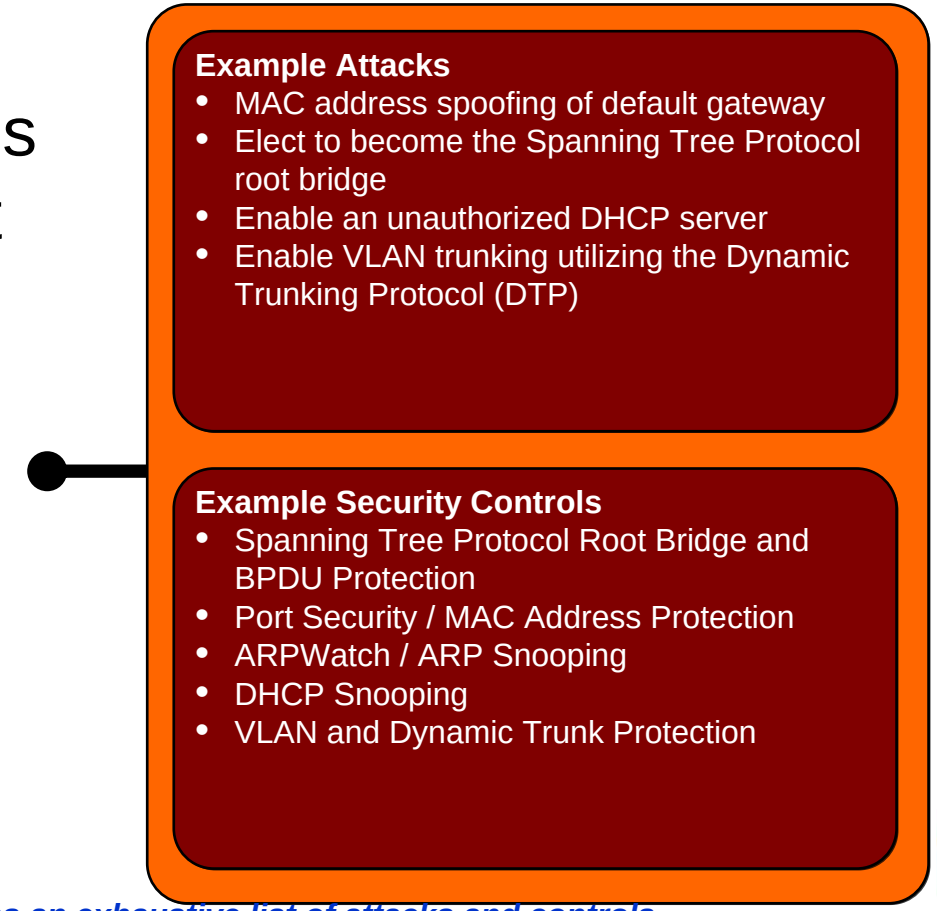
- Attacker reads, inserts and modifies information without either party aware
  - **Physical Layer**
  - Datalink Layer
  - Network Layer
  - Application Layer
  - System Layer
  - Social Layer




**** Not to be considered as an exhaustive list of attacks and controls***

# Man-in-the-Middle Attacks* (3 of 7)

- Attacker reads, inserts and modifies information without either party aware
  - Physical Layer
  - **Datalink Layer**
  - Network Layer
  - Application Layer
  - System Layer
  - Social Layer

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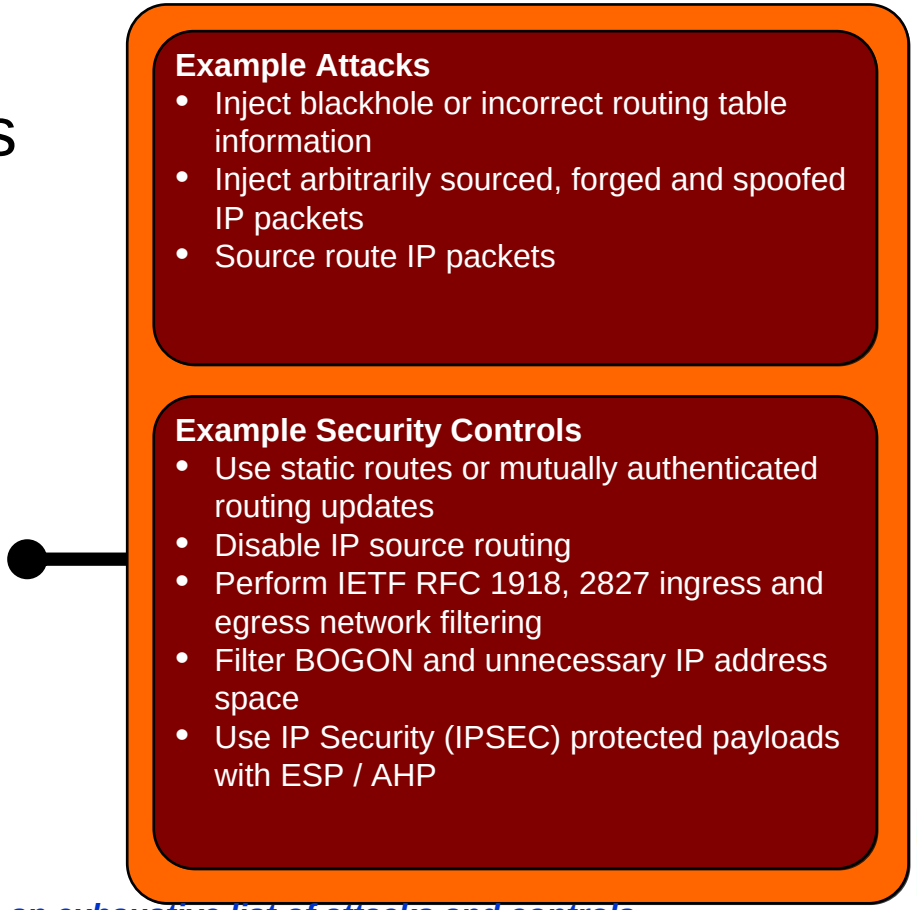
# Man-in-the-Middle Attacks* (4 of 7)

- Attacker reads, inserts and modifies information without either party aware
  - Physical Layer
  - Datalink Layer
  - **Network Layer**
  - Application Layer
  - System Layer
  - Social Layer




** Not to be considered as an exhaustive list of attacks and controls*

# Man-in-the-Middle Attacks* (5 of 7)

- Attacker reads, inserts and modifies information without either party aware
  - Physical Layer
  - Datalink Layer
  - Network Layer
  - **Application Layer**
  - System Layer
  - Social Layer

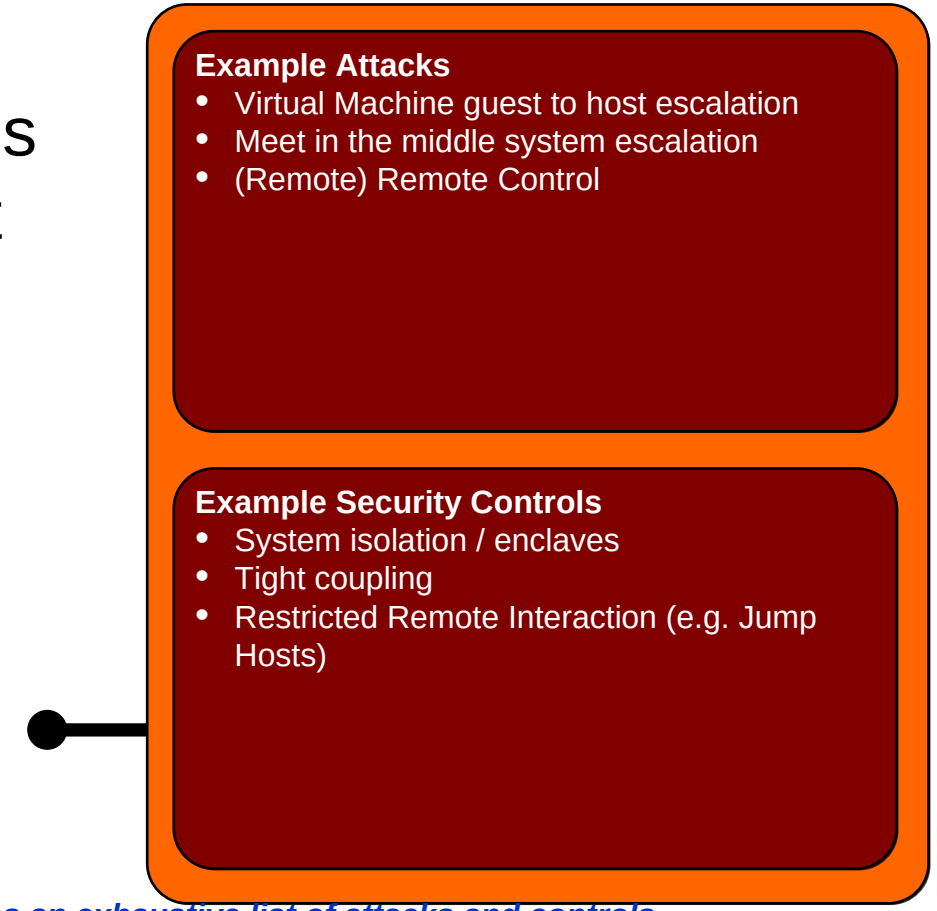
**Example Attacks**
- DNS cache poisoning
- Web browser cookie eavesdropping and manipulation
- Web browser cross site scripting / cross site request forgery
- Digital certificate impersonation
- Generic TCP Session Hijack

**Example Security Controls**
- Split DNS within enclaves
- Static host tables
- Trusted website browsing
- Contained application environments
- Stringent review of certificate trusts
- Limiting interdependencies
- Mutual Strong Authentication

**** Not to be considered as an exhaustive list of attacks and controls***

# Man-in-the-Middle Attacks* (6 of 7)

- Attacker reads, inserts and modifies information without either party aware
  - Physical Layer
  - Datalink Layer
  - Network Layer
  - Application Layer
  - **System Layer**
  - Social Layer

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# Man-in-the-Middle Attacks* (7 of 7)

- Attacker reads, inserts and modifies information without either party aware
  - Physical Layer
  - Datalink Layer
  - Network Layer
  - Application Layer
  - System Layer
  - **Social Layer**

**Example Attacks**
- Phishing / Pharming / Whaling
- V-Phishing (Vishing)
- Telephone Calls
- Business Card / Name Dropping
- Identity Theft

**Example Security Controls**
- Party or Request Validation
- Identity Validation and Monitoring
- CAN SPAM Act
- Truth in Caller ID Act Legislation
- Legislation to alter processing of "Change of Address" forms

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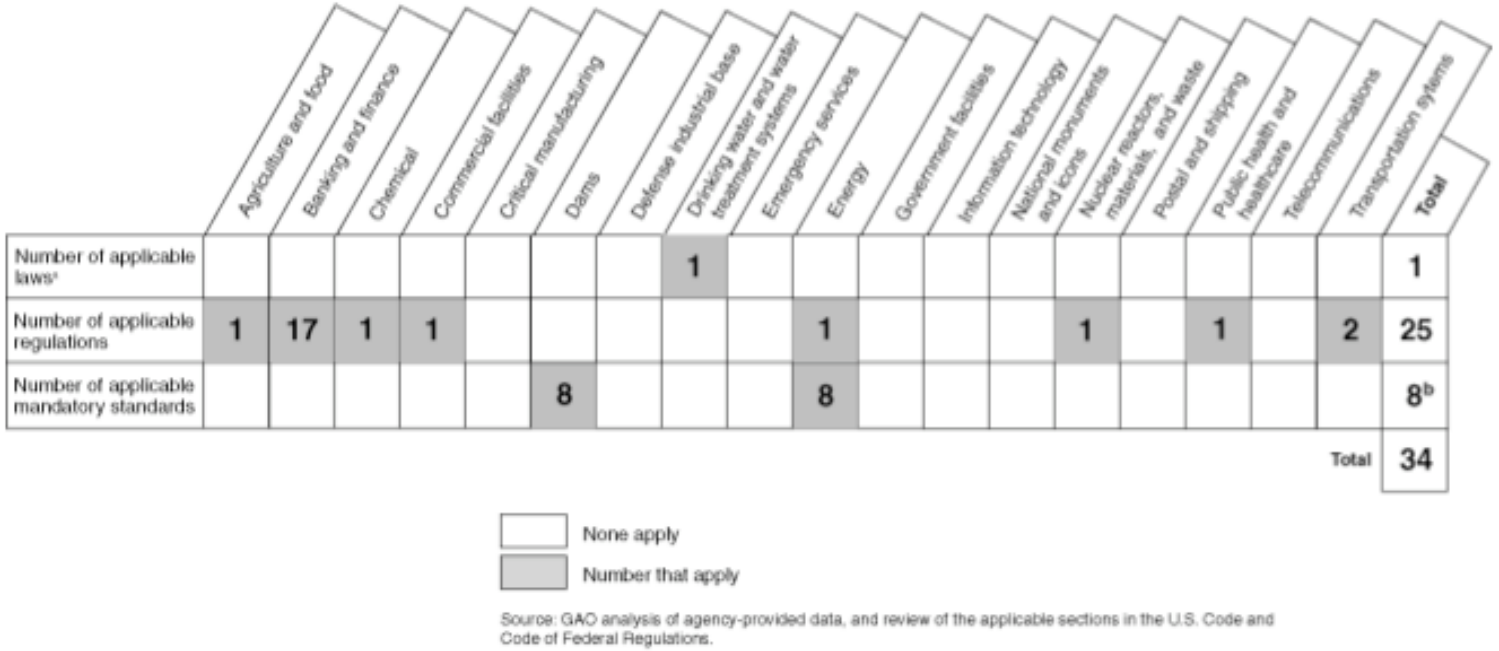
# What are the rules of the game? Critical Infrastructure Protection

# Critical Infrastructure Federal Legal Requirements

**Figure 1: Summary of Federal Legal Requirements for Securing Privately Owned IT Systems and Data within Critical Infrastructure Sectors**



| | Agriculture and food | Banking and finance | Chemical | Commercial facilities | Critical manufacturing | Dams | Defense industrial base | Drinking water and water treatment systems | Emergency services | Energy | Government facilities | Information technology | National monuments and icons | Nuclear reactors, materials, and waste | Postal and shipping | Public health and healthcare | Telecommunications | Transportation systems | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of applicable laws[a] | | | | | | | | 1 | | | | | | | | | | | 1 |
| Number of applicable regulations | 1 | 17 | 1 | 1 | | | | | | 1 | | | | 1 | | 1 | | 2 | 25 |
| Number of applicable mandatory standards | | | | | | 8 | | | | 8 | | | | | | | | | 8[b] |
| | | | | | | | | | | | | | | | | | | Total | 34 |

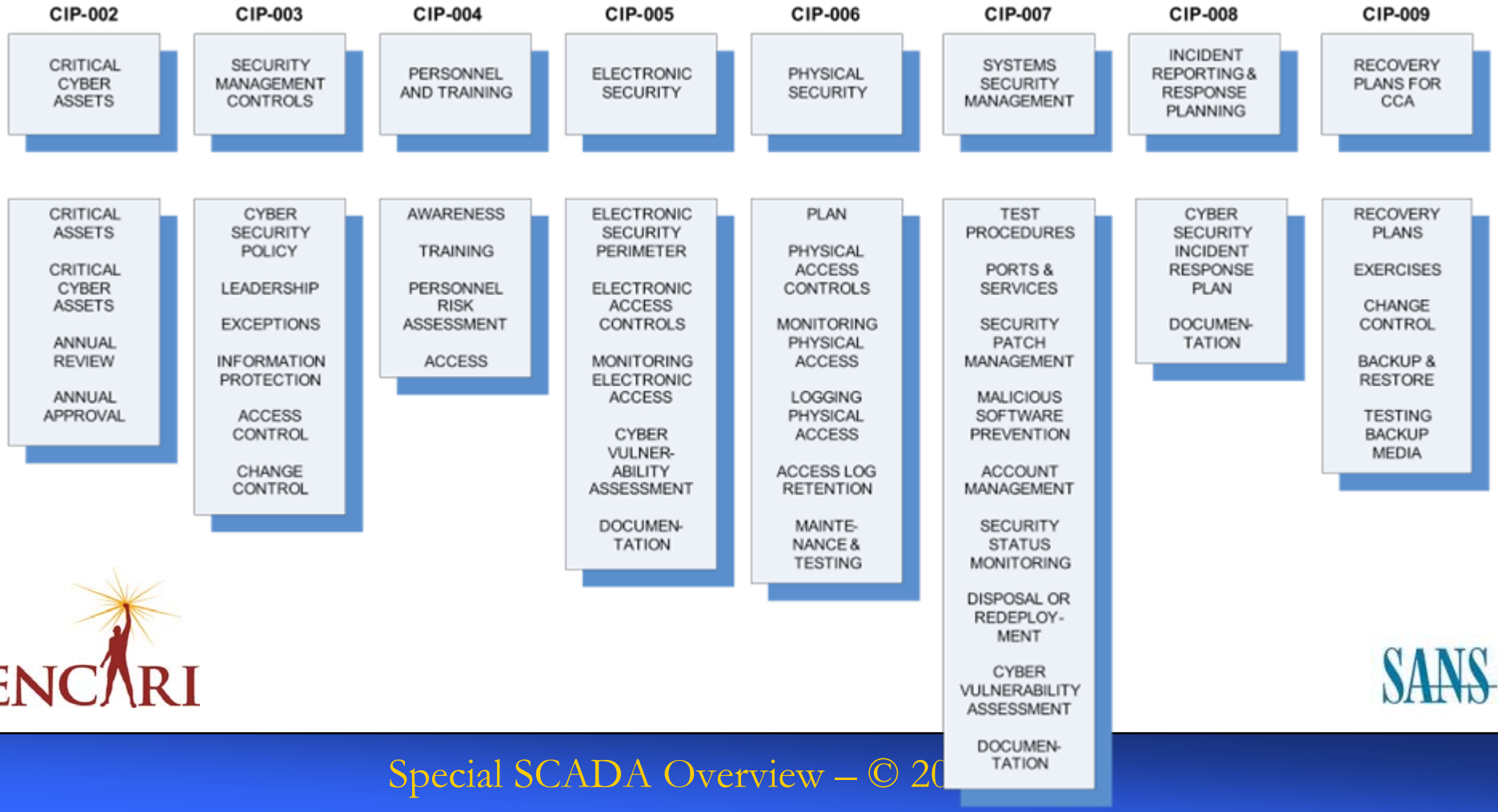
None apply

Number that apply

Source: GAO analysis of agency-provided data, and review of the applicable sections in the U.S. Code and Code of Federal Regulations.

**InformationTechnology: Federal Laws, Regulations, and Mandatory Standards for Securing Private Sector Information Technology Systems and Data in Critical Infrastructure Sectors, September 16, 2008 GAO Briefing**

# NERC CIP Reliability Standards (Regulated Requirements)

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# CIP Past

- FERC SMD Appendix G
- NERC UAS-1200
- NERC 1300
- NERC CIP 002-009
- NERC CIP-001
- FERC Order 693
- FERC Staff Assessment
- FERC CIPS NOPR
- FERC Order 706

- Influential Factors
- NE Blackout 2003
- “Aurora”
- SANS CIA briefing
- News media in general

# CIPS In A Nutshell...

- ***Critical Infrastructure Protection*** *Standards (CIPS) are intended to protect the following:*
  - Bulk Power System (Bulk Electric System)
  - Critical Assets
    - Control Centers, Transmission Subs, Generation Plants
  - Critical Cyber Assets
    - EMS, DCS, RTUs, IEDs, PLCs, Relays
    - Decision Support Systems
  - Critical Infrastructure Information
- Provide greater reliability through greater security and accountability

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# PENALTIES!
# The Cost of NERC CIP Non-Compliance

- Compromised reputation, potential loss of customers and business partners, ...
- Potentially a lot of money

**Appendix A: Base Penalty Amount Table**

The following lists the Base Penalty amounts corresponding to combinations of violation risk factor and violation severity factor.

| Violation Risk Factor | Violation Severity Level | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Lower | | Moderate | | High | | Severe | |
| | Range Limits | | Range Limits | | Range Limits | | Range Limits | |
| | Low | High | Low | High | Low | High | Low | High |
| Lower | $1,000 | $3,000 | $2,000 | $7,500 | $3,000 | $15,000 | $5,000 | $25,000 |
| Medium | $2,000 | $30,000 | $4,000 | $100,000 | $6,000 | $200,000 | $10,000 | $335,000 |
| High | $4,000 | $125,000 | $8,000 | $300,000 | $12,000 | $625,000 | $20,000 | $1,000,000 |

NOTE: This table describes the amount of penalty that could be applied for each day that a violation continues, subject to the considerations of Section 3.21 regarding frequency and duration of violations.

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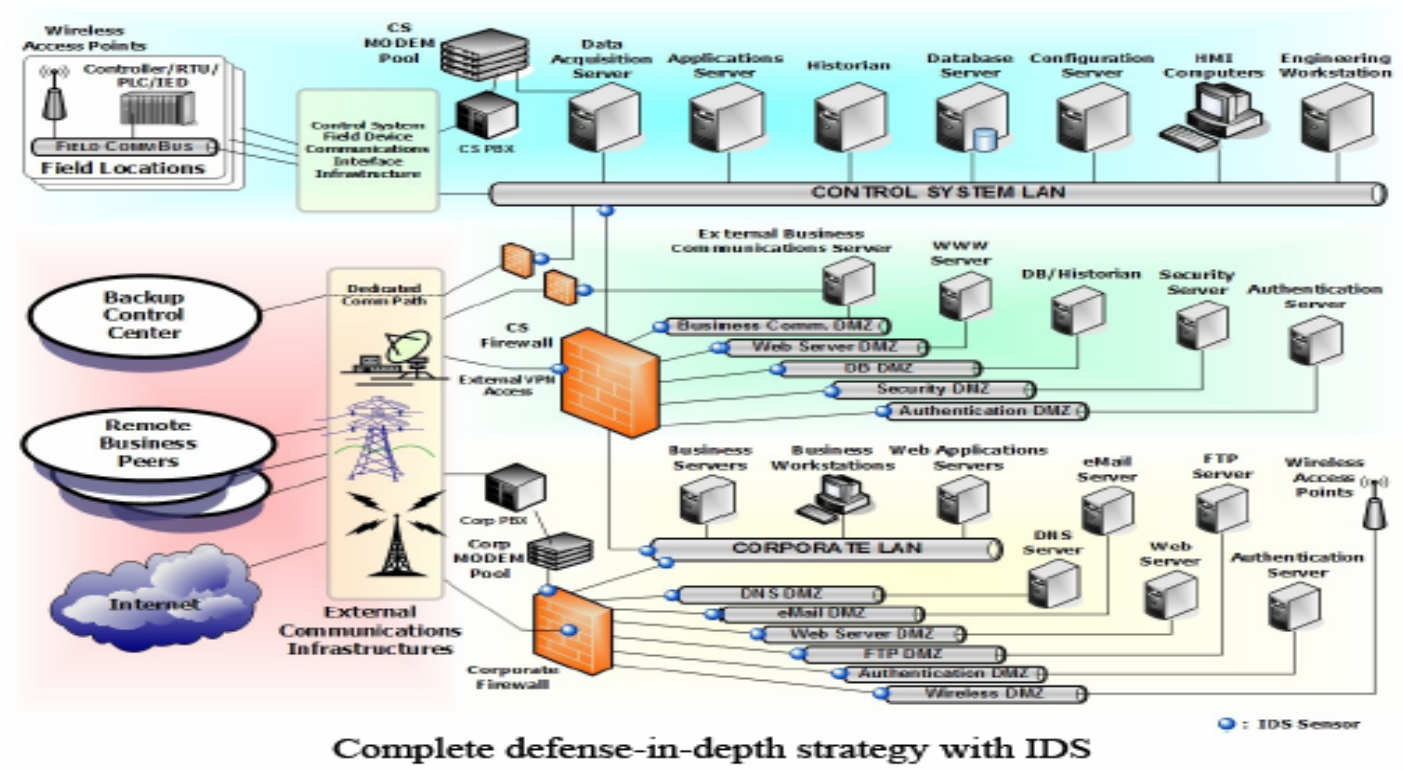
# International, National and Organizational Standards

- NERC CIP
- ISA S99
- ISO 27001
- NIST SP 800-53 r2, 800-82
- NRC
- IEC 62351
- NNSA
- DoD 8500.1
- IEEE P1686
- IEEE P1711
- IEC 61850 (Cigre B5.38)

http://www.us-cert.gov/control_systems/csstandards.html

# NIST SP 800-82 Example Architecture




Complete defense-in-depth strategy with IDS

Source: Idaho National Laboratory, Control Systems Cyber Security: Defense in Depth Strategies (May, 2006)

# Apply Vertical Intelligence of Other Critical Infrastructures

- Healthcare
  - Life supporting solutions
- Finance
  - Integrity of transaction
- Telecommunications
  - Robust, fault-tolerant communications system
- Electric Utilities (SCADA/DCS)
  - Safety, Reliability, System Criticality, Vendor Systems

# Simple Principles to reflect upon while architecting

# Simple Principles

- Isolationism provides protection
  - The more isolated an environment is from others the greater the success of physical and logical security controls assuring continuously accurate information and control

# Simple Principles

- Assets will be physically stolen or lost

  - Physical assets, physical assets storing electronic information and electronic assets will be stolen or lost
  - You must limit the impact of any theft of information

- Your conversations will be eavesdropped upon
  - Any verbal, paper or electronic conversation can be monitored; you must be accepting of this and utilize the appropriate protective controls to limit your risk

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# Simple Principles

- Build with a moat (control)
  - Separate trust levels / Security Enclaves
  - Understand how the moat (control) works

* Nijo Castle
Kyoto, Japan

- (or) Build with Nightingale Floors *

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# Air Gaps Not Only Answer

- “Computer Virus Strikes Space Station”
- August 27, 2008: Tariq Malik space.com
- A virus designed to swipe passwords from online gamers has inexplicably popped up in some laptop computers aboard the international space station.
- The low-risk virus was detected on July 25, but did not infect the space station's command and control computers and poses no threat to the orbiting laboratory, NASA officials said.

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# Holistic Approach

- Threats, Vulnerabilities, and Consequences
- Standards and Regulations
- People, Process, and Technology


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# Do you have a choice to play?
# Risk, Key Takeways and Q&A

# Encountered Themes of Risks

- Too much public information about the system
- Poor communication procedures throughout the industry regarding cyber security
- Growing interdependent, interconnected legacy systems
- Insufficient security awareness and security training
- Constrained ability to tactically execute and enforce documented policies, standards and procedures
- Attrition of workforce

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# Key Takeaways

- Assure holistic and integrated involvement with people, processes and technology
- Maintain ongoing situational awareness operationally, physically and cyber (internally and externally)
- The discovery process may prove to be difficult – remember to understand all components including environmentals
- Key architecture components are crucial (electronic and physical perimeters, authentication, logging, remote management, change management, development, data storage, communication flow)
- Architect and build for incident response
- Defense in depth
- Security awareness and training to combat workforce attrition
- NERC CIP Reliability Standards are paving the way for future legislation and compliance requirements for international electric utilities and critical infrastructures

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# Q&A

- Contact Information
  - Matthew Luallen – Co-Founder, Encari
    - 312-375-4715
    - mluallen@encari.com

- Visit our blog at Control Engineering magazine's website
  - www.controleng.com


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